

```

1  # -*- coding: utf-8 -*-
2  """
3  Created on Tue Mar 26 19:46:14 2019
4
5  @author: Nate
6  """
7
8  import numpy as np
9  import matplotlib.pyplot as plt
10 import pdb
11
12
13 '''
14 Determine the value of  $\pi$  to  $\approx 14$  digits by solving for the root of the equation
15
16  $f(x) = \cos(x) = 0$ 
17
18 using the second order Newton's method. The exact solution is
19
20  $x = \pi/2$ , so that  $\pi = 2x$ .
21
22 Use the initial guess of  $x = 1.5$ , corresponds to a guess of  $\pi \approx 3$ . How many
23 iterations are needed to achieve 14 digits? Repeat the calculation with initial guesses
24  $x = 1$ ,  $x = 0.5$  and  $x = 0.25$ .
25 '''
26
27 def f(guess):
28     return np.cos(guess)
29
30 def df(guess):
31     return -np.sin(guess)
32
33
34
35 guess = [1.5, 1, .5, .25]
36
37
38 for i in range(len(guess)):
39     for val in range(4):
40         nextguess = guess[i] - f(guess[i])/df(guess[i])
41         guess[i] = nextguess
42
43     if i == 3:
44         answer = guess[i]
45         #print(guess[i])
46         #print(answer)
47         print(i, ":", " ", (3/2)*np.pi-answer)
48         if abs((3/2)*np.pi-answer) < 10**(-12):
49             print('True')
50     else:
51         answer = 2*guess[i]
52         print(i, ":", " ", np.pi-answer)
53         if abs(np.pi-answer) < 10**(-12):
54             print('True')
55
56 print(10**(-10))

```